## **Astronaut's Perspective**

## Risk Management

- Risk Evaluation Question:
  - "Do the Benefits outweigh the Risks?"

- Benefit
  - Gain
- Risk
  - Probability of Loss

### Risk Evaluation Question:

- "Do the Benefits outweigh the Risks?"

### – Gains:

 Success, Advancement, Money, Fame, Prestige, Power, Exhilaration, Adventure, Excitement, (Competition)

### -Losses:

 Failure, Schedule Delay, Money, Embarrassment, Demotion, Hardware Damage, Injury, Death

- Types of Risk in Programs
  - -1. Business Risk
    - Cost or Schedule Challenges
    - (Usually not personal injury)
  - 2. <u>Technical Risk</u>
    - Probabilities of Mission Success
      - Task and Procedure Complexity
    - (Can involve injury or loss of life)

- 1. <u>Business Risk</u> (Cost / Sched)
  - Standard Business Practices
    - Past Performance
      - Metrics, Earned Value, Schedules, Progress Reports
    - Present Performance
      - Procedures, Cost Performance Index, Efficiencies,
         Optimization, Toyota Production System
    - Future Predictions
      - Estimated cost At Completion, Red/Green Stoplights, Management Reserves

## **ISS Risk Matrix**

#### RISK DEFINITIONS

RISK: An ISS Program Risk is any circumstance or situation that poses a threat to: crew or vehicle safety, Program controlled cost, Program controlled schedule; or major mission objectives, and for which an acceptable resolution is deemed unlikely without a focused management effort. Agreements between the International Partners (IPs) that are not being fully implemented must be documented as ISS risks. (ISS Risk Management Plan)

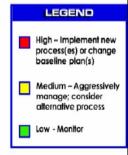
WATCH ITEM: A potentially significant threat to the ISS Program. A William be effectively managed internally by the managing organization with existing team resources and processes (little coordination laterally or vertically is required for effective mitigation).

RISK MANAGEMENT: An organized, systematic decision-making process that efficiently identifies risks, assesses or analyzes risks, and effectively reduces or eliminates risks to achieving program goals. (ISS Risk Management Plan)

ISS RISK MANAGEMENT APPLICATION (IRMA): The ISS database used to track ISS risks and provide ISS risk status reports to the ISS Program management. URL: http://mod.jsc.nasa.gov/irma

#### What is the likelihood the situation or circumstance will happen? Probability Level ... or - the current process ... cannot prevent this event, no alternative approaches or processes 5 Very High 4 High cannot prevent this event, but a different approach or process might. 3 Moderate may prevent this event, but additional actions will be required. o 2 is usually sufficient to prevent this type of event is sufficient to prevent this event.





#### RISK CONSEQUENCE SCORING TERMS

- 1 Cost is defined as the dollar amount required to mitigate the risk, not the cost of the risk if it occurs.
- Schedule definitions: Level 2 Schedule relates to ISS hardware delivery dates and Level 1 Schedule relates to ISS launch dates.
- Technical definition includes everything that is not cost and schedule: e.g., safety, operations, programmatic.
- 4 Cost, Schedule, and Technical Consequences can exist concurrently and are not mutually exclusive.
- 5 Risk scoring is accomplished by "multiplying" Likelihood X Consequence. When determining risk consequence among Cost, Schedule, and Technical, the highest score is represented in the ISS Risk Matrix as a single score value.

	What is the Consequence (Cost, Schedule, or Technical) of this ISS Risk?								
c	Level	1	2	3	4	15			
COMMOD	Cost	Minimal Impact of < \$100K	Budget Increase between \$100K and \$1 Mil	Budget Increase between \$1 Mil and \$10 Mil	Budget Increase between \$10 Mil and \$50 Mil	Budget Increase of > \$50 Mil			
EZ		Minimal or No Impact	Additional Activities Required. Able to Meet Need Dates	Level 1 Schedule or Level 2 Schedule Milestone Slip of = 1 Month	Level 1 Schedule or Level 2 Schedule Milestone Silp of = 1 Month, or Program Critical Path Impacted	Cannot achieve Major ISS Program Milestone			
읕	Technical	Minimal or No Impact	Moderate Reduction, Same Approach Retained	Moderate Reduction, But Workarounds Available	Major Reduction, But Workarounds Available	Unacceptable, No Alternatives Exist			

- Policies
  - Standards, Requirements
- Safety
  - Hazard Analysis, Controls, PRA
- Reliability
  - FMEA, CIL
- Quality
  - Design, Test, Inspect, Surveil, Audit

- Boards, Processes
  - Design Reviews [PDR, CDR]
  - Problem Resolution Teams (PRT)
  - Control Boards [MICB, SICB, PRCB]
  - Operational Reviews [PAR, FRR, L-2, MMT]

- Maintenance
  - Operations and Maintenance Requirements and Specifications Document (OMRSD)
  - Operations and Maintenance Instruction (OMI)
  - Change Request (CR)
  - Requir. Change Notice (RCN)

- Operations
  - Launch Commit Criteria
  - Flight Rules
  - Crew Procedures
  - Problem Tracking
    - PRACA, CAR, PR, MR, IFA

- Technical Risk Mitigation
  - Organizational Control (Corporate)
    - Policies
    - Training, Tools, Resources
  - Personal Control (Individual / Team)
    - Procedures
    - Situational Awareness, Judgment, Values, Ethics

## Deficiencies

- Executives and Managers
  - Push decisions down, encourage <u>risk</u> acceptance at lower levels
    - Tough decisions not made at top, deniability
    - Shift responsibility and accountability
  - Don't want Bad News

## Deficiencies

### Supervisors and Workforce

- Eager to please bosses
  - Ironically, fall into culturally acceptable trap
    - Compliance and
    - Willing Acceptance of Responsibility and Accountability
  - "Sunshine Reports"
    - Optimistic Status Reports
    - Optimistic Problem Resolution plans

## Deficiencies

- Technical Risk Personal Control
  - Discussions regarding future death rarely occur
    - 1. Socially Unwelcome (Team)
      - Unproductive
      - Unwritten Rule, Superstition, Community Taboo
    - 2. Thoughts <u>Not Entertained</u> (Individual)
      - Faithful Trust
      - Comfortable Ignorance
      - Sense of Invulnerability

# **Comparative Risk**

	U.S. Air Carriers	Military Combat Jet	Space Shuttle
Cost per Vehicle	\$42 M (G-V) \$75 M (737)	\$49 M (F18)	\$2,000 M
Pilot Flight Time			
Risk of Loss			

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Risk of	1 / 3,700,00	1 / 20,000	1 / 57
Loss	('94-'03)	(Since WWII)	

 Comparison between Operators and Managers:

### **Operators**

High Confidence
Healthy Self-Doubt

### **Managers**

High Confidence
Healthy Self-Doubt

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High Values

 Comparison between Operators and Managers:

### **Operators**

High Confidence
Healthy Self-Doubt

(Hand-Eye Coordin.?)
Mental Discipline
Operate under stress
[threat of death]

### **Managers**

High Confidence
Healthy Self-Doubt

(Elevated Intelligence?)
High Values
Make effective decisions
[threat of anguish]

## **Examples**

- "Risky Program" Excuse
  - "We can make the Shuttle as safe as possible, and then we'll never fly."
    - Sends two messages:
      - 1. Generic: We're willing to accept additional risk
      - 2. Specific: We don't want to address your issue
- Accusations of "Risk Aversion"
  - Provokes Dangerous Decisions

## **Examples**

- "Risk Aversion" Response:
  - How much risk we are willing to accept?
    - Challenge ourselves to accept more risk
- More relevant Question:
  - How do we distinguish between unnecessary risk and necessary risk?
    - How do we eliminate the former and mitigate the latter?

## Mitigating Risk

- High Reliability Organizations
  - Address Every Issue
    - Listen, evaluate
    - Make Decision Objectively
      - Accept necessary risk,
      - Don't accept unnecessary risk
      - Provide rationale, re-evaluate
        - » Might convince the more conservative people that additional risk is acceptable
        - » Encourage continued conservatism
      - Elevate, commensurate with magnitude of issue, especially if there is disagreement

## Summary

- Ineffective Risk Decisions
  - Risk/Benefit Bias
  - Misunderstood or Ignored Risks
  - Fail to Postulate Accident
    - Loss of Life
    - Loss of Assets
    - Psychological Consequences

## Summary

## Effective Risk Deliberations

- Consider the Risk
  - Understand Probabilities
  - Deliberate Candidly, Objectively
- Manage the Risk
  - Eliminate the Unnecessary Risk
  - Mitigate the Necessary Risk

## Summary

<u>Effective</u> Risk Deliberations (cont'd)

- Acknowledge the Consequences
  - Be Willing to Forgo the Benefits
  - Be Willing to Accept the Losses
- Integrate Accumulated Risk
  - Collective Wisdom is Needed
  - Communication is Crucial